DOCUMENT RESUME

ED 377 896 JC 950 026

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TITLE The INVEST Program: A Computer-Based System for Adult Academic Upgrading. A Pilot Project.
PUB DATE Nov 92
NOTE 41p.; For a related document, see JC 950 027.
PUB TYPE Reports - Research/Technical (143) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Adult Basic Education; Community Colleges; Comparative Analysis; *Computer Assisted Instruction; Computer Networks; *Computer Software Evaluation; Foreign Countries; Integrated Learning Systems; Mathematics Instruction; *Outcomes of Education; Participant Satisfaction; *Program Effectiveness; Remedial Reading; Student Characteristics; Two Year Colleges
IDENTIFIERS *INVEST Computer Assisted Learning System; Nova Scotia

ABSTRACT

A study was conducted for the Cumberland Campus of Nova Scotia Community College to determine whether a heterogeneous group of adult learners could make significant gains in academic achievement using a computer-based learning system, and how such gains compared to those associated with more traditional learning approaches. A sample of 15 students, with an average age of 32.27 and a mean education level of 9.33 years, participated in an 11-week course using INVEST, a networked system of basic instructional software offering lessons in reading, writing, mathematics, and life skills. Two groups were used for comparison, one with a younger mean age which had completed an 18-week course, and one with an older mean age which had completed a 44-week program. Study findings, based on standardized tests administered before and after program participation, included the following: (1) attendance for the INVEST sample was 92.6%, while the mean number of hours on the computer was 151.77; (2) positive gains were made by the study group in all areas of reading and mathematics, while for mathematics, gains of more than 1.5 years were made in the 11-week period; and (3) after adjusting for program length, gains in reading skills were greater for the comparison groups but gains in mathematics were greater for the INVEST group. Based on findings and positive reactions from participants, it was recommended that the program be adopted as a supplement to traditional approaches. Tables and study instruments are appended. (KP)

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ED 377 896

THE INVEST PROGRAM
A COMPUTER-BASED SYSTEM FOR ADULT ACADEMIC UPGRADING

A PILOT PROJECT

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November, 1992

JC 950 026

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ACKNOWLEDGEMENTS

The support of Employment and Immigration Canada is gratefully acknowledged and, in particular, the Amherst Office. Among those who provided assistance and support to the project were the following: Mr. George Laird, Principal, Cumberland Campus of the Nova Scotia Community College System, Ms. Margaret Norton, Vice-Principal, and Mr. Andrew Moore, Instructor. Technical assistance was provided by Dr. Joe Murphy, Department of Education, Dalhousie University, and Dr. Robert Sealey, Mount Allison University.

PURPOSE OF STUDY

The purpose of this study was to determine the value of a computer-assisted approach towards academic upgrading and to determine whether and to what extent this approach would be comparable to more traditional teaching approaches when applied to a diverse group of adults seeking academic upgrading.

BACKGROUND TO THE PROJECT

The use of computers in education has been common practice for the past twenty-five years. The last ten years has seen what may be termed a 'microcomputer revolution' particularly in the public schools. Despite its history, the impact of this technology on such matters as student achievement, attitudes and learning time remain largely unclear. The application of computers to education has been primarily for skill building in mathematics and language arts. Results of studies of computer-assisted instruction(CAI) which have examined the effects of computer-based drill and practice have led to the general conclusion that substantial gains in achievement scores do occur primarily in mathematics and less consistently in areas of language learning.

The results of CAI studies with adult learners have been less clear-cut. There have been far fewer programs developed for adults as they have represented a relatively small target group for CAI developers. Consequently, there have been insufficient studies of adults upon which to draw firm conclusions as to the efficacy of computer-based learning approaches for adults. And, CAI systems for adults have often been simple extensions of systems developed for school-aged learners. The extent to which such systems are appropriate to the needs and learner characteristics of adults has not been well-addressed.

There is a growing need for adults to return to school and for service providers to offer programs appropriate to the adult learner. CAI appears to have great potential. The adult learner represents a more heterogeneous learner group. The range of skills, aptitudes, interests, attitudes and motivation varies considerably. Many benefits of CAI approaches when applied to adults are evident: individualization of learning, step-by-step structure to learner tasks; multiple entry levels; flexibility; unlimited practice; privacy; twenty-four hour use capability, etc. There would also appear to be potential benefits regarding reduced costs and reduced training time.

The present study was designed to determine whether a heterogeneous group of adult learners could make significant gains in academic achievement over eleven weeks of training on a computer-based learning system, and how such gains would compare to those associated with more traditional learning approaches.

DESCRIPTION OF THE CAI PROGRAM

The INVEST System(Josten's Corporation) consists of a Local Area Network(LAN). Twelve student stations are linked together to a mainframe computer called a CPU or File Server. The File Server does the report keeping, lesson sending and file recovery. The server has an eight megabyte capacity and is linked to two peripherals called CD-Roms. The compact disk players send certain parts of the curriculum across the network through the File Server. Student stations have two megabyte capacity and are fixed to the File Server through a series cable connector and baseband extender board. Each student station is equipped with a peripheral called a digi-speech adaptor. The digi-speech adaptor controls the voice and microphone components of the system. A microphone and headset allow each student to hear and reply to lessons sent across the network. Each student station is fixed with a personal boot disk and station bootup number.

Software. There are two main vehicles of software in the Josten's learning system: INVEST and The Basic Learning System. INVEST consists of a program that has a three-tier construction. Tier 1 is Literacy Basic(Levels 1-3), Tier 2 is Adult Basic Education(Levels 4-8), and Tier 3 is GED Preparation Advanced Literacy(Levels 9-12). There are approximately 4000 lessons in the entire INVEST curriculum.

The Curriculum. Each curriculum level contains a number of different lesson strands in the content areas of Reading, Writing, Mathematics, and Lifeskills(See Appendix 1). Students in the INVEST system are tested in two different ways in each individual lesson strand. Each student receives a pre-test and a post-test. The pre-test evaluates prior knowledge in a particular subject area while the post-test evaluates mastery of the concepts learned in the lesson strand. Students must achieve a mastery percentage before they can continue with their learning. The mastery percentage is set by the instructor. If a student reaches the mastery percentage on the pre-test, then the student may be leap-frogged through the lessons on this particular strand. If mastery is not achieved, the student goes through the lessons until the post-test is reached. If mastery is not achieved on the post-test, the student returns for further remedial lessons.

The system also "recognizes" when a student is having difficulties in a particular lesson. Each student is thoroughly evaluated in each lesson. If a student does not meet the mastery level, the system will lock the student out of the lesson depending on the criteria set by the instructor. The instructor may set the computer to lock a student out of a lesson after the first, second, or third unsuccessful attempt. In such a case the prompt "No Lessons To Work On -- See Your Instructor" will be given to the student. If a student does exceptionally well in a series of lessons, the system can also move the student forward. Again, the criteria for this function can be controlled by the instructor. For purposes of this study, mastery level was set at 85%.

DESIGN

Selection of Samples

Study Group. As the intent of the program was to determine the efficacy of a computer-based system for adult retraining, it was agreed that the selected group for study should be representative of a "typical" group seeking academic upgrading through the community college system of Nova Scotia. Such adult groups tend to be heterogeneous with regard to factors such as age, academic background, present levels of achievement, and previous work experiences. Thus, a decision not to preselect candidates along a range of variables was made. Since the INVEST program was purported to be effective across a range of ability and achievement levels, it was argued that such a diverse group would provide suitable testing of the program. The final group, consisted of 15 students of which there were 9 females and 6 males. The average age was 32.27 years(range 20-47 years). The mean educational level was 9.33 years. The program began on Monday, 22 June, 1992 and ended on Friday, September 11, 1992.

Comparison Groups. Because of the heterogeneity of the study group, attempts to find suitable comparison groups where more traditional approaches to upgrading had been undertaken were limited. However, it appeared valuable to gain some understanding as to the expected gains to be achieved in more traditional programs of comparable length in order to provide some standard for the study group. A particular problem was that there was no concurrent traditional program under way at the time of the initiation of this study. Thus, possible comparison groups to which appropriate pre-testing and post-testing could be applied were not available. And, standard methods of evaluation were not always available regarding previous programs. Two groups were considered for comparison. Comparison Group 1 consisted of 10 students(7 male, 3 female) who had completed an 18-week program in a more traditional teacher-instructed setting. The program ran from March until June, 1992. The mean age of the group was 20.3 years(range 19-21 years) and the mean educational level was 10.11 years. Comparison Group 2 had taken part in a 44-week traditional training program. This program ran from September, 1991 until June, 1992. It consisted of 15 students(8 male, 7 female) whose mean age was 38.4 years and the mean educational level was 8.71 years. For both comparison groups, no controls were possible regarding subject selection, teaching methods, nor methods of evaluation.

Test Instrumentation

Measures of Academic Growth. Two standardized measures of achievement were administered prior to program initiation and at the end of the 12 weeks. It should be noted that the measures were chosen as they had been used regularly with similar adult populations in the system. The *Canadian Adult Ability Test(Level C)(CAAT)*(Harcourt Brace Jovanovich, 1989) is a battery of tests designed to measure the educational achievement levels of adults with varying amounts of previous formal schooling. Among the subtests are the following: Vocabulary, Reading Comprehension, Spelling, Number Operations, Problem-Solving, Language Usage, Science and Mechanical Reasoning. The *CAAT Level C* was recently standardized on 3927 adults of varying ages, backgrounds, present educational programs, and sex. Information regarding reliability and validity is presented in the Norms Manual(Harcourt Brace Jovanovich, 1989, Pp. 41 - 44). Reliability studies were limited to measures of internal consistency. No information on test-retest reliability is presented. For purposes of this study, the following subtests were considered: Vocabulary, Reading Comprehension, Number Operations, Problem

Solving, and Total Mathematics(Operations plus Problem Solving). Only Comparison Group 1 had received the *CAAT* both before and following the 18-week program.

The *Test of Adult Basic Education(TABE)*(Level D) is a norm-referenced battery of tests designed to measure adult achievement in reading, mathematics, language and spelling. It had been developed in parallel with the California Achievement Test. Technical data regarding reliability and validity studies is not provided in the Examiner's Manuals although general reference to the parallel development of these two tests is made. *Forms 5 and 6* (CTB/McGraw Hill, 1987) are parallel forms which include the following subtests: Vocabulary, Comprehension, Mathematics Computation, Mathematics Concepts and Applications, Language Mechanics, Language Expression and Spelling. Total Reading(Vocabulary plus Comprehension), Total Mathematics(Computation plus Concepts and Applications) and Total Language(Mechanics plus Expression) scores were also generated. *Form3(*CTB/McGraw-Hill, 1976) is an earlier edition of the TABE and includes the following subtests: Vocabulary, Comprehension, Capitalization, Punctuation, and Mathematical Computation, Concepts, and Problems. As noted above, technical information regarding test development is not available in the Examiner's Manual. All persons in Comparison Group 2 as well as 5 members of the Study Group had completed *Form 3* at pre-test and *Form 5* at post-test. The remainder(n=9) of the Study Group was administered *Form* 6 before and *Form 5* following the program. The following subtests were considered: Vocabulary, Comprehension, Total Reading, Math Computation, Math Concepts, and Total Math.

Other Measures. A number of other measures were developed for this project. An *Attitudes to Learning Survey* was developed by the Evaluator as an informal measure of student attitudes towards self, learning and computer-based instruction(See Appendix 2). It consisted of 23 statements which were rated on a 10-point scale from Extremely Poor to Extremely Good. It was administered prior to entrance and upon program completion. The *Program Evaluation Questionnaire(PEQ)* was developed by the Evaluator to provide participants with an opportunity to evaluate all aspects of the INVEST programmed (See Appendix 2). Answered anonymously, it included both open- and closed-ended questions, as well as questions answered on a 5-point rating scale. *Student and Instructor Diaries* were also kept. Each student was given a disk and asked to keep two files. The first file was confidential and was used to encourage students to write on a daily basis. The second file consisted of an interactive teacher-student file in which students were encouraged to write to the Instructor on a daily basis in order to express questions or concerns, progress, etc. The Instructor responded to each writing of the student. The Instructor's Diary contained daily observations of the program, the participants, and any other matters which were considered to be of importance. As well, weekly *INVEST Reports* were generated to provide information regarding variables such as Time on Computer, Time on Curricular Areas, and Attendance. Finally, the Evaluator kept an informal diary regarding visits to the classroom, observations, and comments by instructors and students.

An informal "Computer-Assisted Learning Student Evaluation" was developed and administered by the Instructor at the mid-point of the program. It consisted of 9 open-ended questions which were answered anonymously. The purpose of this questionnaire was to provide further information regarding student attitudes to the program and to raise any problems or concerns.

Procedure

Pre-testing. Prior to the formal beginning of the program, the students were brought in for two full days of orientation. During this time, they received an orientation to the computer and to the INVEST program. The *TABE, CAAT,* and the *Attitudes to Learning Survey* were completed during this time.

Curriculum Implementation. Since the INVEST program can be used for a range of learners in a number of curricular areas and given that the program would last only 11 weeks(given that some days would be for pre-testing and post-testing), decisions were made as to which curricular areas to include and what amount of time was to be devoted to each area. An examination of the "INVEST Curriculum Overview Number of On-Line Lessons" (Josten's, 1991) indicated the relative hours by curricular area(Reading, Mathematics, Writing, Life Skills) for the three achievement levels(GED, ABE, Literacy). Priority was given to two areas of the curriculum: Reading and Mathematics with secondary importance attached to Writing and Life Skills. Relative ratios by area were determined in order to plan the time to be spent on the computer in each area over the 12-week program. Then, the time by curricular area on versus off the computer was determined. It was determined that the on-line time to be given to Mathematics and Reading relative to Writing and Life Skills would be of the ratio of 4:1. Off-computer time was spent in workbooks and teacher-directed activities. Finally, the determination of a weekly schedule was made in conjunction with the Instructor. After Week I, minor alterations were made to the schedule in order to work out the "kinks". The weekly schedule which was followed for the final 10 weeks of the program, and details regarding the relative amount of computer time devoted to each curricular area, and the relative time of computer versus workbook time by curricular area are included in Appendix 1. Since the relative time allotted to Writing and Life Skills was minimal, formal evaluation of these two components was not undertaken.

The Evaluator visited the program on a bi-weekly basis. These included both announced and unannounced visits. Attempts were made to come at differing points during a day, and on different days during the week. During each visit, at least one-half hour was spent in the classroom.

RESULTS

Attendance for the 12-week program for the total group was 92.67%. The mean number of hours on the computer was 151.77 with 59.24 in Reading, 59.35 in Mathematics, 9.74 in Writing and 23.44 in Lifeskills and other non-academic on-line work. Figure 1 depicts the percentage of total time spent on the computer by curricular area for the Study Group. Approximately 80% of the time was spent on the computer doing Reading or Mathematics with the time divided evenly between the two areas.

Measures of Achievement. Table 1 presents the mean raw scores for the Study Group and for Comparison Group 1 on the subtests of the *Canadian Adult Achievement Test(CAAT)*. Two-tailed paired *t*-tests between the pre-test and post-test raw scores of the *CAAT* for each group resulted in significant positive changes($p < .0001$) for both groups on Number Operations and Total Math. A significant positive change($p < .005$) for the Study Group was found for Problem-Solving, and for Comparison Group1 on Reading Comprehension and Vocabulary($p < .05$).

Table 2 presents mean raw scores for the Study Group on the subtests of the *Test of Adult Basic Education(TABE)*. Note that the scores are based upon those 9 students who completed parallel forms(5/6) of the *TABE*. Using the mean raw scores, two-tailed *t*-tests between pre-test and post-test scores resulted in the Study Group showing significant positive changes on Mathematical Computation and Total Mathematics($p < .005$) as well as Mathematical Concepts and Reading Vocabulary($p < .05$).

Since different versions of the *TABE* were used between pre-test(Form 3) and post-test(Form 5) for Comparison Group 2 as well as for 5 members of the Study Group, grade equivalent scores were derived in order to make comparisons. Assuming that the two versions of the TABE measured similar aspects of achievement and with the shortcomings associated with using t-tests with derived scores, Table 3 indicates significant positive changes($p < .001$) for Math Computation, Math Concepts & Problems, and Total Math for Comparison Group 2. Significant positive changes for the 5 students in the Study Group who had had similar pre-test and post-test forms of the *TABE* resulted for Math Computation($p < .005$).

In order to compare the effects of the different programs, corrections for program length were made. All raw scores for both the *CAAT* and the *TABE* were expressed as grade equivalent scores. Difference scores between pre-testing and post-testing were obtained on each of the subtests. Whereas the Study Group was in program for 11 of 12 weeks, Comparison Group 1 was in program for 18 weeks and Comparison Group 2 for 44 weeks. Using a ratio of 0.61 for Comparison Group 1 and a ratio of 0.29 for Comparison Group 2(allowing for approximately 5 weeks for holidays, etc.), Table 4 presents the corrected scores as gains in grade equivalents relative to an 11-week program. Figure 2 presents a bar graph comparing the Study Group to Comparison Group 1 on the *CAAT*. Whereas the growth in Reading skills was greater for the Comparison Group, the growth in Mathematics was greater in the Study Group, specifically in Problem Solving. Figure 3 presents the gain scores for the Study Group(n=9) based upon the *TABE* results. Significant gains of more than one and one-half years in Mathematical Computation and Mathematical Concepts can be noted. No comparison group was available. Finally, Figure 4(see Appendix 3) presents the results for Comparison Group 2 and the subset of the Study Group(n=5) who had received different forms of the *TABE* test. These latter results are not consistent with other findings and strongly suggest that Forms 3 and 5 of the *TABE* measure differing aspects of academic achievement.

Program Evaluation Questionnaire. All 15 participants completed the *Program Evaluation Questionnaire.* The results for the *PEQ* are presented in Table 5. Regarding the quality of the program, participants rated the on-line computer program higher than the off -line workbook activities. On-line Mathematics was rated as Excellent or Above Average by 66% of participants and on-line Reading by 60% of participants. In the open-ended questions, there appeared to be a perception that the gains in Mathematics had been greater than in other areas. Notable comments included: "I know how to do math. I can figure things I couldn't before," and, "I feel I have accomplished a great amount in Mathematics." Eighty-seven per cent of participants said they would recommend the program to others of similar background, and 87% said they would have an interest in taking part in further related programs. Among the comments were the following: "I learned more than I ever did in school. It made me want to learn." Over 73% of participants thought the program should have been longer than 11 weeks. Regarding the personal effects of this program, 80% of participants felt they were more highly motivated as learners as a result of the program. Seventy-three per cent felt they were both better and more confident learners. A comment regarding the overall program was as follows: "It was an easy way to make entrance into the classroom after being absent so many years to these surroundings. Stepping stones to the future." When compared to more traditional programs, 66% of participants felt the computer program was better. However, 80% indicated that there should have been more time with the Instructor.

Other Measures. The mean raw scores for pre-test and post-test results of the *Attitudes to Learning Survey* are presented in Table 6. Two-tailed paired *t*-tests between pre- and post-test scores on individual items indicated no significant changes.

Other Information. The observations of the Instructor provided valuable insights. First, it appeared that the role of teacher as a motivator of learners and of keeping students on task was largely removed by the CAI approach. More student control and responsibility resulted. As well, this approach provided the Instructor with excellent and more exact monitoring capacities for each student's progress and for any point in time. Finally, the Instructor found that the system allowed him to accommodate a wider range of learner levels. Overall, the Computer-assisted approach was judged by the instructor to be a valuable asset to his teaching. On the other hand, the Instructor noted some of the frustrations of not being able to provide more traditional small-group instruction.

Following completion of the program, all participants were invited to an informal meeting with the Instructor and the Vice-Principal of the Community College. The purpose of this discussion was to provide participants with a further opportunity to discuss their opinions and feelings towards their experiences in this program. The Evaluator was present, but only as a recorder. While observing, the following comments appeared to reflect total agreement among participants: (1) There was a need for more direct instruction by the Instructor; (2) The computer approach was judged to be valuable; (3) There should not be more than one chance to respond to test items; (4) The workbooks were much less valuable than the time spent on computer; (5) The workbooks need to be tied to specific lessons on the computer so that the student moves off the computer directly to the same content in the workbook. As well, there was general consensus that there was too much American content and too many American spellings.

DISCUSSION

In judging the value of the INVEST program, both quantitative and qualitative data must be consicered. Standardized testing revealed that positive gains were made in all areas of Reading and Mathematics. The extent of the gains in Mathematics was greater than those found for the traditional teaching approaches, and was particularly evident in the areas of Mathematical Concepts and Problem-Solving. In fact, gains of more than one and one-half years were realized in an 11-week period. This finding should be given particular attention. It has often been argued that the computer can offer most to mathematical drill and practice. However, the present findings suggests that improvement in conceptual understanding does take place, and that it is occurring more than in traditional approaches. This would not have been predicted at the outset. The gains in reading were not statistically significant, but were in a positive direction and paralleled the relative gains noted in one of the two comparison groups. The younger age(20.30 years) of this comparison group when compared to the Study Group(32.27 years)and the consequent shorter time since leaving full-time attendance in school may have been an influencing factor in the gains found in reading vocabulary and comprehension for this former group. The results which examined the differing forms of the TABE for part of the Study Group and Comparison Group 2 must be interpreted with caution. The gain scores reported for the Study Group are not consistent with other findings, and suggests that the changes reflect differences in test versions rather than "real" gains.

The consensus of the participants as indicated in the post-evaluation questionnaire, the group discussion, the interim evaluation and the diaries suggest that there were many positive features to the INVEST Program which, if used appropriately, would lead to a constructive and successful adjunct to the teaching of adults. The desire for a longer program, for further computer-based programs, and the overwhelming recommendation of the participants to other potential learners would support the continued use of the INVEST curriculum. Other information supports this position. For example, shortly after its inception, students began arriving as much as one-half hour before classes were to begin, would stay through breaks, shorten their lunch hours and even stay after class in order to get extra time on the computer. Students also wanted to take materials home in order to get ahead by working at night. The rate of attendance was also high(93% versus 79% for Comparison Group 1) and would have been higher if judgements were made as to the reasons for absences. And, all members of the class lived in a community approximately 20 kilometers from the campus and arranged their own transportation. Neither meals nor daycare was provided as in other programs on campus during the regular term. Members of the class were meaningfully engaged in academic tasks for virtually all of the time spent in the classroom. The Evaluator was struck by the fact that no matter when he arrived at the classroom, all students were actively engaged in work and the noise level was minimal. The Instructor commented on how focussed the learners were as well as the minimal need to motivate students extrinsically. Students also helped each other on the computers. These factors no doubt led to participants' claims to being better learners, more highly motivated and more confident. Finally, since the completion of the computer-based program, some members of the Study Group have gone on to other traditional programs at the community college. Instructors have noted that these Study Group students "stand out" from their peers in matters of goal-directedness, classroom leadership, and positive attitudes to learning. They also have been noted to question more, and to have a stronger need to understand. Many have continued to keep their diaries.

On the other hand, that over 80% of participants wanted more direct instruction from the Instructor in combination with the unanimous agreement of participants that they would like more traditional teaching and more student-teacher interaction strongly indicates that the CAI approach is **not** a replacement for good teaching, but a valuable aid for the teacher. The expressed need for more instructor time was clarified in the group discussion to be a need for more direct teaching relative to parts of the computer program. An interesting comment made in the group discussion was that students often got an answer correct on the computer, but needed reassurance of the teacher that they indeed understood it. Where a computer can teach a skill, it may not give the confidence to the learner that the skill has been learned.

Failure to find significant positive changes on the attitudes to learning questionnaire was not unexpected since pre-test scores were high and all in the positive direction. Not unlike responses to other attitudinal questionnaires, there would appear to be some influence of social desirability on participants. That is, since the pre-test was given under the conditions where participants were being selected to the study group, it would seem reasonable that they would want to appear to be positive in their attitudes to learning.

Finally, from observations and comments from the Instructor, several additional advantages to the program should be noted. First, the program allows the instructor to pinpoint areas of relative weakness, and to assign lessons specific to overcoming that weakness. Second, if used appropriately, the system should allow the instructor to devote his time and attention to matters of instruction for which the teacher is most effective--modelling, explanation, the development of higher level thinking skills and, of course, one-to-one and small group teaching. In other words, the system has the potential to make the instructor more effective and efficient. On the other hand, the Instructor noted that reference to the teacher as "manager" in the INVEST system misinterprets and potentially undervalues the role to be played by the teacher. The Instructor should be there to teach first and also to "manage" the system. The Instructor emphasized the need for intensive training for the teacher on the system prior to program implementation in order to ensure that the Instructor can engage in meaningful teaching and not simply manage the system.

CONCLUSIONS & RECOMMENDATIONS

The purpose of this study was to determine the value of a computer-assisted approach towards academic upgrading and to determine whether and to what extent this approach would be comparable to more traditional teaching approaches when applied to a diverse group of adults seeking academic upgrading. The conclusion to be drawn is that the INVEST program can provide comparable academic growth in the areas of reading and provides greater growth in mathematics with particular effectiveness in the area of problem-solving. Overwhelming support for the program, for the continuation of the program, and for its availability to other potential users was provided by the participants themselves. And, there is some evidence that improved attitudes to learning as well as generalization of those attitudes to subsequent upgrading programs occurred. Finally, there was a clear indication that the role of the Invest program was that of a teaching tool, i.e., as an adjunct to good teaching. The Instructor must be much more than a "manager" of the system.

The following recommendations are made:

1. The INVEST Program should be adopted for ongoing use at the community college level as a supplement to more traditional approaches to teaching.
2. The INVEST Program should be used as a resource primarily for the upgrading of mathematical skills as well as for specific reading skills.
3. The Instructor should spend more time in group-related instruction relative to parts of the program, and to be more involved in small group and one-on-one assistance to students.
4. Other community college instructors should be trained in order to maximize the use of the INVEST Program.
5. Further use of the INVEST Program should be accompanied by ongoing evaluation in order to better determine how this valuable resource can be used in the adult learning environment.

LIMITATIONS OF THE STUDY

In concluding this report, certain limitations of the findings should be noted. First, the heterogeneity of the study group placed restrictions on the generalization of these findings to other adult groups. From an evaluation perspective, designs which encourage non-treatment controls and a more selective process for participants is to be encouraged despite the limitations of sampling which do exist. The need to use a comprehensive set of measures of academic growth which relate more directly to the content of the Invest program, as well as other well-standardized measures of adult achievement will be required. Since informal followup has provided some" evidence" that there has been positive growth and transfer from this program experience, there is a need to measure potential transfer and generalization effects of the program. There is a need to determine the optimal balance of traditional versus CAI teaching time, the appropriate length of program(Josten's recommends a minimum of 6 months) and which areas are best suited to CAI. Therefore, further evaluation studies on other groups of adult learners in other settings must to be undertaken with the INVEST Program before firm conclusions as to its educational effectiveness can be determined.

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TABLE 1: STUDY GROUP VS. COMPARISON GROUP 1 ON CANADIAN ADULT ACHIEVEMENT TEST RAW SCORES

	STUDY GROUP(N=15) (11 WEEK PROGRAM)					COMPARISON GROUP 1(N=10) (18 WEEK PROGRAM)			
SUBTEST	Pretest	Post-test	t	signif		Pretest	Post-test	t	signif
Vocabulary	23.93	25.07	1.79	n.s.		21.10	23.00	2.82	0.050
Rdg Comprehnsn	39.87	41.53	1.07	n.s.		34.80	40.20	2.45	0.050
No. Operations	25.67	31.00	4.98	0.001		22.20	31.20	6.93	0.001
Problem Solving	18.53	22.67	3.37	0.005		20.80	20.20	-0.55	n.s.
Total Math	44.2	53.73	4.69	0.001		43.00	51.40	5.32	0.001

TABLE 2: STUDY GROUP PRE- & POST-TEST RAW SCORE PERFORMANCE ON THE ON THE TEST OF ADULT BASIC EDUCATION

	STUDY GROUP(N=9) (11 WEEK PROGRAM)			
	Pretest	Post-test		
SUBTEST	$\bar{X}$	$\bar{X}$	t	signif
Vocabulary	24.00	25.22	2.35	0.050
Comprehension	32.56	32.78	0.18	n.s.
Total Read	56.56	58.00	1.39	n.s.
Math Computn	34.22	40.00	3.66	0.005
Math Concepts	29.67	33.33	2.91	0.050
Math Total	63.89	73.33	3.61	0.005

TABLE 3: STUDY GROUP SUBGROUP VS COMPARISON GROUP 2
ON TABE GRADE EQUIVALENT SCORES(Form 3 - 5)

	STUDY GROUP(N=5) (11 WEEK PROGRAM)					COMPARISON GROUP 2(N=10) (44 WEEK PROGRAM)			
	Pretest	Post-test				Pretest	Post-test		
TABE	X	X	t	signif		X	X	t	signif
Vocabulary	9.2	10.46	1.89	n.s.		11.26	11.87	0.98	n.s.
Comprehension	8.7	10.32	1.61	n.s.		9.89	11.13	1.65	n.s.
Total Read	8.96	10.3	1.6	n.s.		10.56	11.62	1.83	n.s.
Math Computn	6.94	11.2	5.73	0.005		8.47	12.90	12.51	0.000
Math Concepts	7.84	9.46	2.06	n.s.		9.02	11.90	5.31	0.000
Math Total	7.42	10	4.59	0.010		8.67	12.76	11.42	0.000

TABLE 4: GRADE EQUIVALENT ADJUSTED GAIN SCORES FOR CAAT AND TABE RESULTS

	GAIN SCORES	
CAAT	STUDY GROUP(N=14)	COMPARISON GROUP 1(N=10)
Vocabulary	0.31	0.48
Rdg Comprhnsn	0.60	1.00
No. Operations	1.27	1.26
Problem Solving	1.46	-0.01
Math Total	1.69	0.79

TABE FORM 6 - 5	STUDY GROUP(N=9)
Vocabulary	0.55
Comprehension	0.21
Reading Total	0.50
Math Computn	1.34
Math Concepts	1.90
Math Total	1.99

TABE FORM 3 - 5	STUDY GROUP (N=5)	COMPARISON GROUP2(N=15)
Vocabulary	1.26	0.18
Comprehension	1.62	0.36
Reading Total	1.34	0.31
Math Computn	4.26	1.29
Math Concepts	1.62	0.84
Math Total	2.58	1.19

TABLE 5: RESULTS OF THE PROGRAM EVALUATION QUESTIONNAIRE

1. I liked using this computer approach

42.86%	more than learning by traditional ways
42.86%	as much as learning by traditional ways
14.29%	less than learning by traditional ways
NO RESPONSE(1)	

2. Using this computer approach, I feel I learned

35.71%	more than learning by traditional ways
35.71%	as much as learning by traditional ways
28.57%	less than learning by traditional ways
NO RESPONSE(1)	

3. Rate each part of the Invest Program by the following 5-point rating scale:

Excellent — Above Average — Average — Below Average — Poor

	1	2	3	4	5
Reading on Computer	20.00%	40.00%	33.33%	6.67%	0.00%
Workbooks on Reading	6.67%	13.33%	80.00%	0.00%	0.00%
Mathematics on Computer	40.00%	26.67%	33.33%	0.00%	0.00%
Workbooks on Mathematics	13.33%	33.33%	46.67%	6.67%	0.00%
Writing on Computer	6.67%	20.00%	46.67%	20.00%	6.67%
Workbooks on Writing	0.00%	13.33%	66.67%	20.00%	0.00%
Life Skills on Computer	26.67%	20.00%	53.33%	0.00%	0.00%
Workbooks on Life Skills	13.33%	40.00%	40.00%	6.67%	0.00%

4. Do you think that the 12 week course should have been

73.33%	longer?
13.33%	about this length?
13.33%	shorter?

5. The amount of time spent on the computer each day should have been

40.00%	more
6.67%	less
53.33%	about the same

6. The amount of time spent in the workbooks should have been

6.67%	more
33.33%	less
60.00%	about the same

7. The amount of time spent with the instructor should have been

80.00%	more
0.00%	less
20.00%	about the same

8. How much time could you comfortably spend on the computer at one time?

13.33%	30 minutes
20.00%	1 hour
26.67%	2 hours
13.33%	3 hours
26.67%	all day

9. If given the opportunity to do further programs that were set up like this one, would you have

60.00%	a strong interest in taking part?
26.67%	some interest in taking part?
13.33%	no interest in taking part?

10. Compared to other upgrading programs, do you feel that this computer approach is

66.67%	better
13.33%	about the same
20.00%	not as effective

11. As a result of this course, do you feel that you are

	Yes	No
a better learner?	73.33%	26.67%
a more confident learner?	73.33%	26.67%
more able to concentrate?	66.67%	33.33%
a more highly motivated learner?	80.00%	20.00%

12. Did you find that writing to the instructor by computer to be of benefit? If so, how?

84.62%	Yes
15.38%	No

NO RESPONSE(2)

12. Would you recommend this program to others who have similar backgrounds to your own?

86.67%	Yes
13.33%	No

TABLE 6: PRE-TEST AND POST-TEST MEAN SCORES FOR THE STUDY GROUP ON THE ATTITUDES TO LEARNING SURVEY

	PRE-TEST $\bar{X}$	POST-TEST $\bar{X}$
MEMORY		
Ability to remember what heard	5.67	6.27
Ability to remember what I see	7.67	7.47
Ability to remember what read	7.33	7.27
Ability to remember what teacher told me	6.93	6.80
ACADEMIC ABILITY & INTERESTS		
Overall ability	7.53	7.27
Overall reading ability	6.66	6.73
Speed of reading	5.93	6.13
Interest in reading at home	7.53	7.07
Interest in solving math problems	7.70	6.60
Ability in mathematics	6.80	6.87
Ability to write	7.13	6.27
Handwriting ability	5.80	6.60
Ability to do well on tests.	6.27	6.33
CONCENTRATION		
Ability to concentrate in class	6.67	6.53
Ability to listen to teacher	7.93	8.07
SELF-DIRECTION		
Ability to work on my own in class	7.73	7.80
Ability to keep working when boring	6.07	5.93
Willingness to work when very difficult	6.33	6.80
Willingness to follow teacher's instructions	8.20	8.00
INTEREST IN COMPUTERS		
Interest in trying different ways to learn	7.36	7.29
Interest in computers	8.47	8.13
Interest in learning with computers	8.33	8.27
PEER-RELATED		
Ability to get along with others	8.27	8.47

LIST OF FIGURES

FIGURE 1: Percentage of Time By Curricular Area On-Line

FIGURE 2: CAAT Grade Equivalent Gains: Study Group vs Comparison Group 1

FIGURE 3: TABE Grade Equivalent Gains for Study Group

FIGURE 4: TABE Form 3 to 5 Gain Scores: Study Group vs Comparison Group 2

FIGURE 1: PERCENTAGE OF TIME BY CURRICULAR AREA ON-LINE

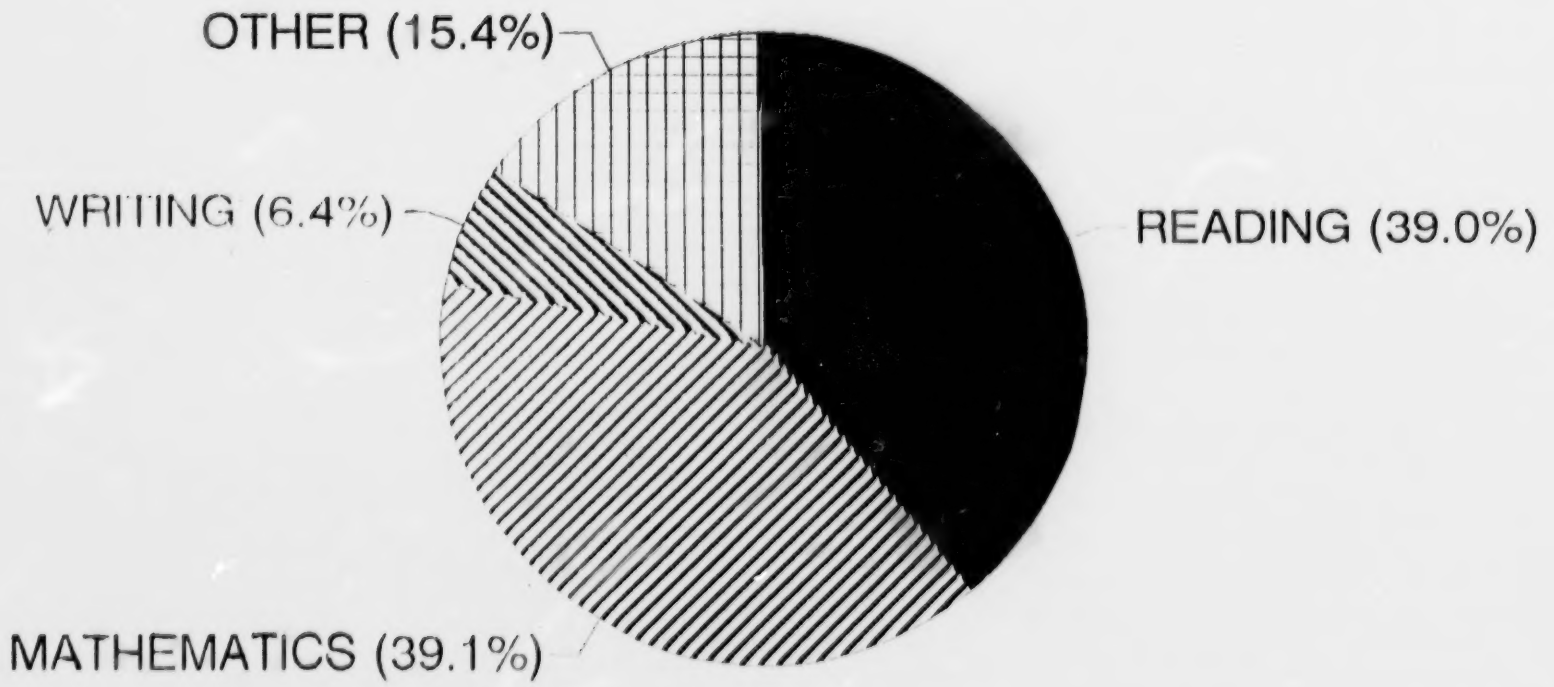


FIGURE 2: CAAT GRADE EQUIVALENT GAINS STUDY GROUP VS COMPARISON GROUP 1

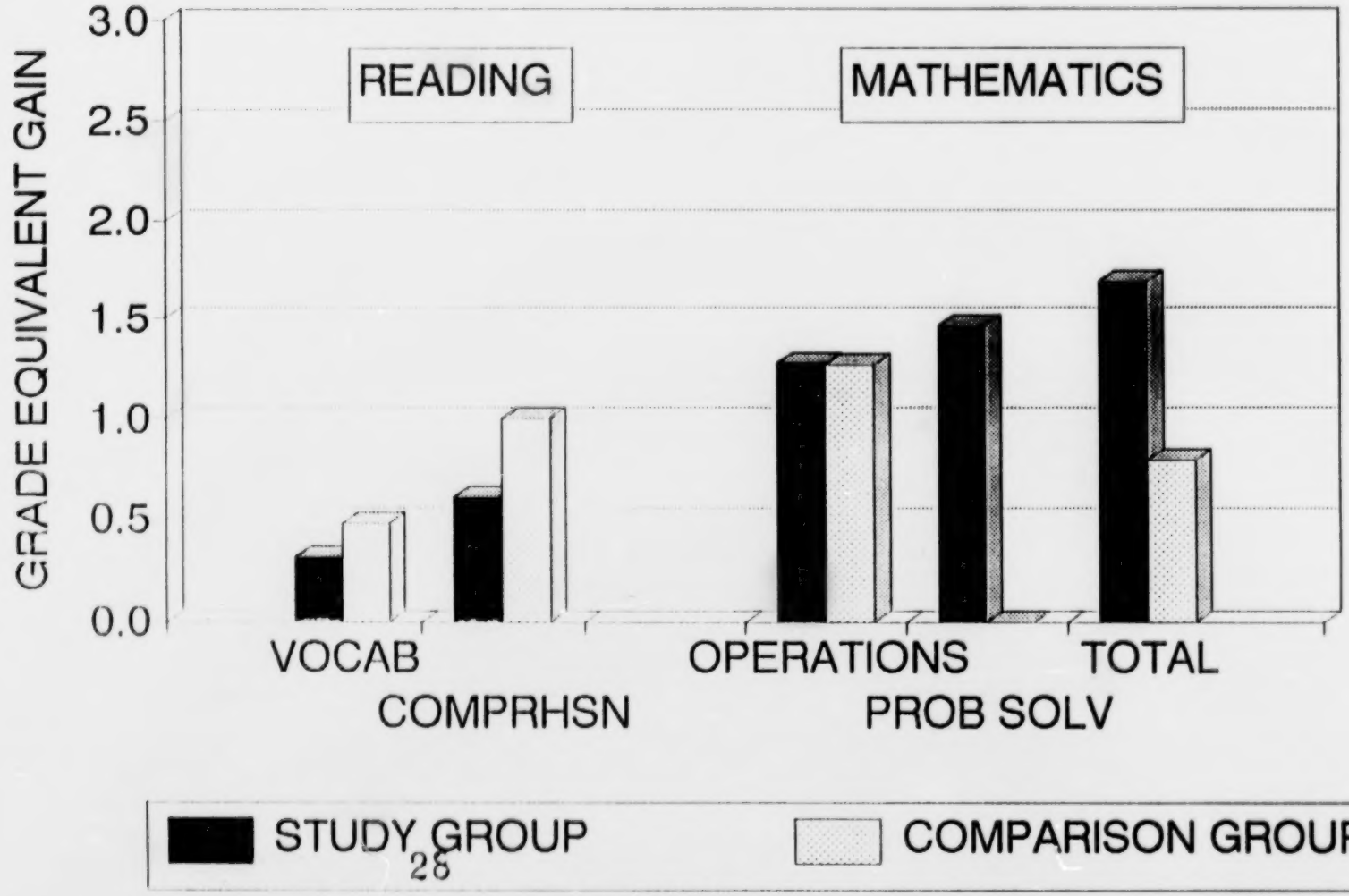


FIGURE 3: TABE GRADE EQUIVALENT GAINS FOR STUDY GROUP

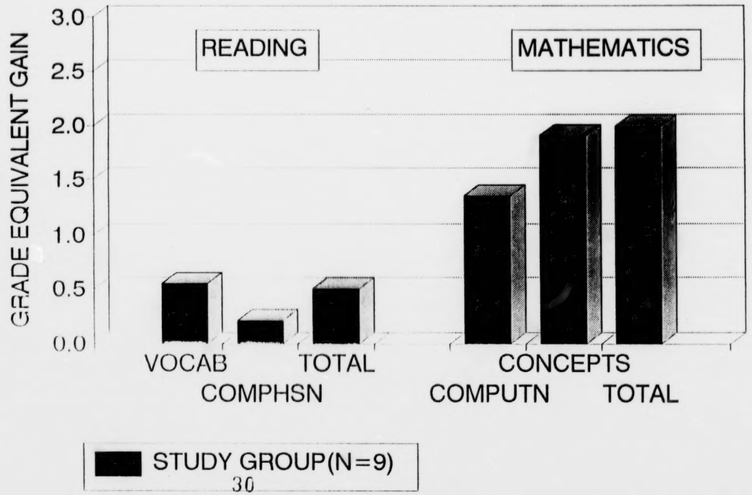
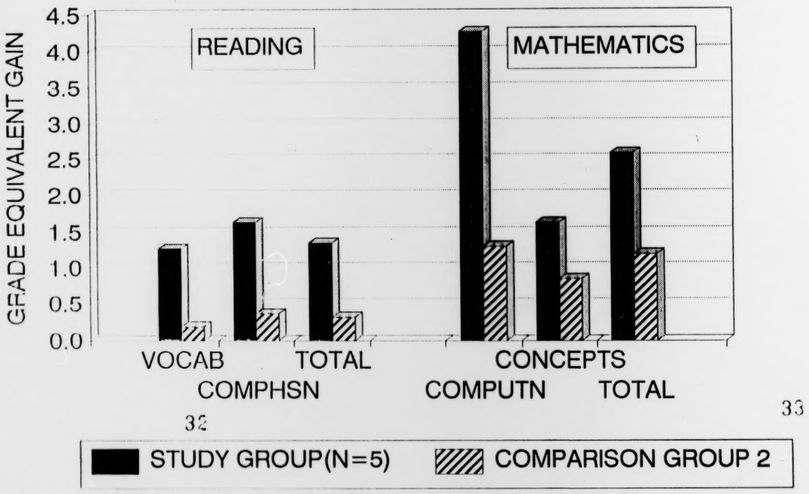


FIGURE 4: TABE FORM 3 TO 5 GAIN SCORES STUDY GROUP VS COMPARISON GROUP 2



APPENDICES

APPENDIX 1: The Invest Program

1.1 Invest - Curriculum Overview

1.2 The Daily Timetable

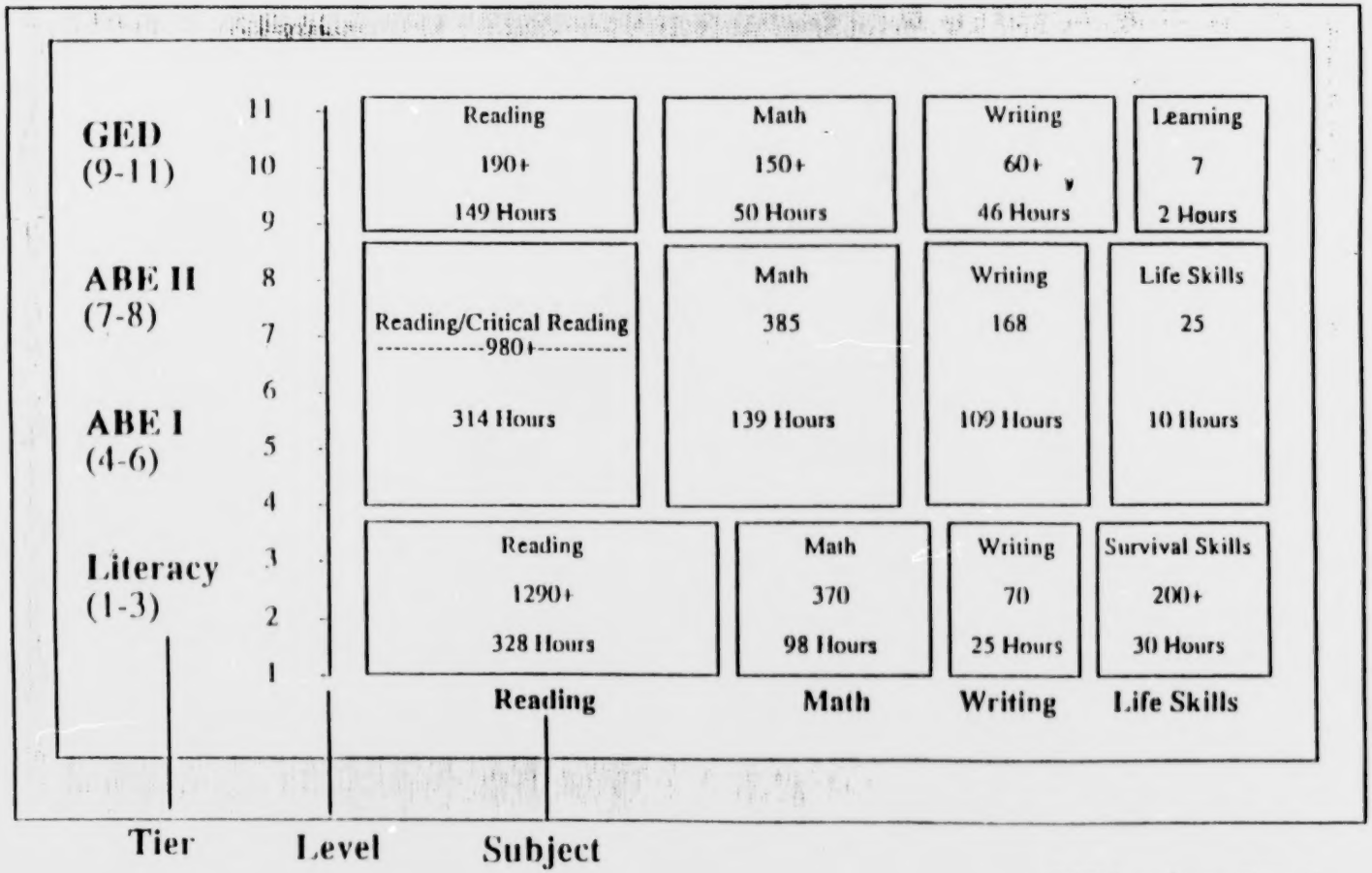
APPENDIX 2: Instrumentation

2.1 Learning Attitudes Survey

2.2 Program Evaluation Questionnaire

APPENDIX 1.1

Invest - Curriculum Overview
Number of On-Line Lessons – 3.0
Number of Hours



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APPENDIX 1.2: DAILY TIMETABLE(WEEKS 2 TO 12)

CLASS	TIME	GROUPS	COMPUTER LESSONS	WORKBOOK LESSONS
1	8:35 - 9:10	A, B	Reading	Group C Reading
2	9:10 - 9:50	A, B	Mathematics	Group C Writing
BREAK	9:50 - 10:00			
3	10:00 - 10:40	B, C	Reading	Group A Writing
4	10:40 - 11:20	B, C	Mathematics	Group A Mathematics
5	11:20 - 12:00	C, A	Writing	Group B Writing
LUNCH	12:00 - 12:45			
6	12:45 - 1: 25	C, A	Reading	Group B Reading
7	1:25 - 2:05	A, B	Writing	Group C Mathematics
BREAK	2:05 - 2:15			
8	2:15 - 2:55	B, C	Writing	Group A Reading
9	2:55 - 3:35	C, A	Mathematics	Group B Mathematics

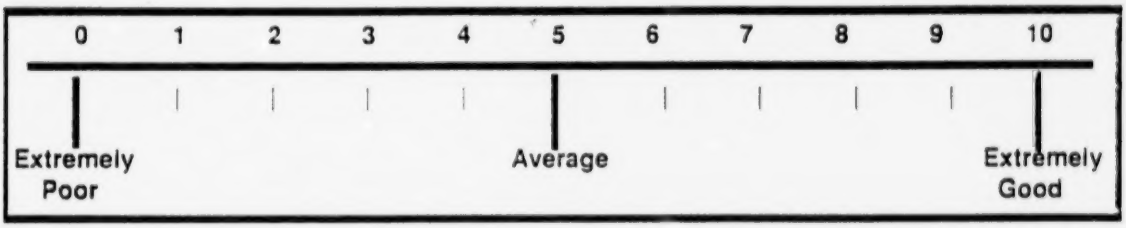
Friday afternoons will be spent on Lifeskills lessons.
Lifeskills will rotate in the same manner: AB, BC, CA.

APPENDIX 2.1: ATTITUDES TO LEARNING SURVEY

SPRINGHILL COMMUNITY COLLEGE
PILOT PROJECT

NAME:

RATE YOURSELF BETWEEN 1 AND 10 ON EACH OF THE STATEMENTS BELOW:



1. My ability to concentrate in class is _____.
2. My interest in solving math problems is _____.
3. My ability to work on my own in class is _____.
4. My interest in trying different ways to learn is _____.
5. My overall reading ability is _____.
6. My ability to keep working even when it's boring is _____.
7. My ability to remember what I hear is _____.
8. My willingness to work at something I find very difficult is _____.
9. My ability to get along with others is _____.
10. My overall ability is _____.
11. My interest in computers is _____.
12. My ability to remember what I see is _____.
13. My ability to remember what I've read is _____.
14. My willingness to follow the teacher's instructions is _____.
15. My speed of reading is _____.
16. My ability to remember what the teacher has told me to do is _____.
17. My interest in reading at home is _____.
18. My ability to listen to the teacher is _____.
19. My ability in mathematics is _____.
20. My ability to write is _____.
21. My handwriting ability is _____.
22. My ability to do well on tests is _____.
23. My interest in learning with computers is _____.

APPENDIX 2.2: PROGRAM EVALUATION QUESTIONNAIRE

THE INVEST PROGRAM

PROGRAM EVALUATION QUESTIONNAIRE

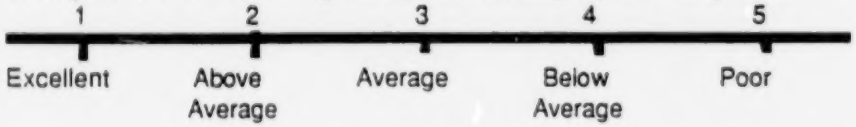
THE PURPOSE OF THIS QUESTIONNAIRE IS TO EVALUATE THE INVEST COMPUTER PROGRAM. ALL OF YOUR ANSWERS WILL BE HELD IN CONFIDENCE. THANK YOU FOR COMPLETING THIS QUESTIONNAIRE.

PART ONE

1. I liked using this computer approach
   - ___ more than learning by traditional ways
   - ___ as much as learning by traditional ways
   - ___ less than learning by traditional ways

2. Using this computer approach, I feel I learned
   - ___ more than learning by traditional ways
   - ___ as much as learning by traditional ways
   - ___ less than learning by traditional ways

3. Rate each part of the Invest Program by the following 5-point rating scale:



Reading on Computer	___
Workbooks on Reading	___
Mathematics on Computer	___
Workbooks on Mathematics	___
Writing on Computer	___
Workbooks on Writing	___
Life Skills on Computer	___
Workbooks on Life Skills	___

4. Do you think that the 12 week course should have been
   - ___ longer
   - ___ about this length
   - ___ shorter

5. The amount of time spent on the computer each day should have been
   - ___ more
   - ___ less
   - ___ about the same

6. The amount of time spent in the workbooks should have been
   - ___ more
   - ___ less
   - ___ about the same

7. The amount of time spent with the instructor should have been

___ more
___ less
___ about the same

8. How much time could you comfortably spend on the computer at one time?

___ 30 minutes
___ 1 hour
___ 2 hours
___ 3 hours
___ all day

9. If given the opportunity to do further programs that were set up like this one, would you have

___ a strong interest in taking part?
___ some interest in taking part?
___ no interest in taking part?

PLEASE COMMENT

10. Compared to other upgrading programs, do you feel that this computer approach is

____ better
____ about the same
____ not as effective

11. As a result of this course, do you feel that you are

	Yes	No
a better learner?	___	___
a more confident learner?	___	___
more able to concentrate?	___	___
a more highly motivated learner?	___	___

12. Did you find that writing to the instructor by computer to be of benefit? If so, how?
PLEASE COMMENT

12. Would you recommend this program to others who have similar backgrounds to your own?

___ Yes
___ No

PLEASE COMMENT

PART TWO

1. If you were involved in this kind of learning again, what would you want to see changed?

2. Were there parts of the program that you found frustrating? If so, please explain.

3. If you feel you are now a better reader, how are you better?

4. If you feel you are now a better writer, how are you better?

5. If you feel you are now better in math, how are you better?

6. If this program were offered again, what would you recommend be changed?